THE BRONZE STATUE OF A YOUTH

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An account of the recreation
of an ancient statue

David Rinne
Jiří Frel

The J. Paul Getty Museum
Malibu, California

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PREFACE

In 1971 the J. Paul Getty Museum purchased a bronze head of a youth. In the following year a bronze foot was added to the Museum's collection.

In the spring of 1973, Dr. Jiri Frel, new Curator of Antiquities at the Museum, decided after studying both pieces that the head and foot must both belong to the same statue, and his conclusion was included in the Museum's *Catalogue of Ancient Art*, which appeared shortly thereafter.

In the fall of that year, while visiting Turkey, Dr. Frel was able to declare that our head and foot were originally part of a bronze torso in the museum at Burdur, and discussed the situation with Professor Jale Inan, of the University of Istanbul.

Subsequently, Mr. Getty agreed that the Museum should undertake an exciting piece of reconstruction: A complete casting of the head, torso, and foot would be made in cooperation with the Turkish authorities.

Early in 1974 we were pleased to welcome Professor Inan, who came to study the bronze head and other sculptures here and to lecture on the ancient statuary recently found in Kremna.

In order to pursue the project, Mr. David Rinne, Conservator of Antiquities, went to Burdur to do conservation work on the torso and also to make molds from it. These molds, together with those of our head and foot, were sent to the Valsuani foundry in Paris so that the reconstructions could be cast. Mr. Rinne made two visits to Paris in order to review the work being done by the foundry. Arrangements were made for the complete statue to come to Malibu, and a casting of the head and foot have gone to Burdur to be displayed with the original torso.

Eventually we will be displaying the reconstructed statue in a small temple near the entrance to the Museum. In the meantime, we have arranged an exhibition in which the complete statue can be seen and compared with the two original parts. In addition, we are showing a plaster cast of the statue colored and finished in the way that the original statue would have been.

In the present exhibition, the original head can also be compared with three more pieces in our collection which go back to the same prototype.

To complete the display Mr. Rinne has provided a noteworthy documentation of the process of bronze casting which has altered little over the past two thousand years.

The J. Paul Getty Museum is proud to have brought together, in scholarship and reconstruction, what remains of this truly noble statue.

Stephen Garrett, *Deputy Director*

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For a conclusive historical appraisal of the Burdur-Getty statue we must await the results of the research by Professor Jale Inan of Istanbul. She has with justification pointed out the similarities between the body of the statue and the Polykleitan Doryphoros. The bronze head,[1] however, seems to come from a different type. In the Museum's *Catalogue*[2] Cornelius Vermeule correctly saw the head as belonging to the time and spirit of Skopas' Meleager and the bronze athlete from Ephesos. Among further parallels he mentions the Hermes from Atalante, emphasizing the similar treatment of the hair. We can take this a step further: The head of the Hermes of Atalante has been recognized as a replica of the head of the Ares Ludovisi.[3] This statue, famous for centuries, has met with a varied fortune at the hands of archeologists, who have attributed it to various masters from Skopas to Lysippos. Today it is universally recognized as an eclectic creation, combining elements of different styles and periods. Thus this head type, undoubtedly fourth century in character, re-appears in several places on other types of bodies. Our collection is fortunate enough to be able to present three marble replicas of the same prototype.

Most impressive is a newly acquired herm,[4] which produces a surprisingly fresh impression, now that the later restorations have been removed. It is a very conscious academic copy which even takes into account the head's original orientation, turned slightly towards the right. The craftsmanship is very competent and dates to before the middle of the second century A.D., the time of the Emperor Hadrian and Antoninus Pius.

The second marble replica[5] is lent to us by J. Paul Getty. Its preservation is less satisfactory but the carving was indisputably more lively — less accurate perhaps, but with greater emphasis on plastic values and richer in facial details. A date of about 100 A.D. seems likely for this copyist's workmanship.

The third piece,[6] already identified as an Ares Ludovisi type in the *Catalogue,* comes originally from a standing draped statue, although it has been adapted in modern times to the form of a bust. This schematized work, with its reduced facial planes and pattern of curls, points to a date in the late third century A.D. The closest parallel for such a use of the Ares Ludovisi head is undoubtedly the standing draped statue of the youth from Eretria in the National Museum, Athens.[7]

The rich possibilities for comparison offered here by these three marble pieces enhance our appreciation of the artistic quality of the bronze head, as well as the craftsman's freer technique. The general character, proportions, and mood, are indisputably the same, not only in the face

but also in the profusion of curls.

As for the casting, both head and foot[8] were made separately from the torso; it must have been cast in a large workshop, where many statues and parts of them were being made, because for reference the founder incised a capital "A" in the mold of the head, inside the neck, to identify to which statue it belonged. It is a pity that by itself the single letter cannot provide much surer evidence for dating the work. Cornelius Vermeule placed it probably in the second century A.D., but it may be even earlier. We all look forward to the results of the metal analysis, in course of preparation by David Rinne, which may contribute to the establishment of the chronology and explain the complicated procedure by which the statue was put together from different parts.

What can be taken for certain at present is that this juvenile image of an athletic hero corresponds well to classicistic taste, combining features of various styles into a sophisticated creation, as was fashionable from late Hellenistic times until the Roman imperial period of the second century A.D.[9]

Jiří Frel, *Curator of Antiquities*

Footnotes

1) 71.AB.450.
2) *Catalogue of the Ancient Art in the J. Paul Getty Museum* (1973), no. 7.
3) See J. Fink, "Ein Kopf für alle," *Römische Mitteilungen,* 71 (1969), pp. 152ff., pls. 34-38.
4) 73.AA.139. Sale catalogue, Sotheby, London, July 5, 1973, no. 96, pl. 32; *Recent Acquisitions: Ancient Art, the J. Paul Getty Museum* (1974), no. 4 (before restoration).
5) I-59. Mario del Chiaro, *Greek Art in Private Collections of Southern California* (1966), no. 22 (before restoration).
6) 71.AA.119. *Catalogue,* no. 53.
7) *Römische Mitteilungen,* 71, p. 153, pl. 38.3.
8) 72.AB.103. *Catalogue,* no. 80.
9) See now the brilliant study by P. Zanker, *Klassizistische Statuen* (Mainz, 1974).

THE BRONZE STATUE OF A YOUTH

Introduction

Generally speaking museums have little interest in reproductions of works of art. However, the circumstances relating to the recent re-creation of an ancient bronze statue for the Getty Museum were so special as to demand a reappraisal of this general rule.

The initial impetus for the project came from the discovery that a Hellenistic bronze head and foot in the Getty collection had originally been part of a bronze torso now in the Burdur Museum of Turkey. Of course, neither museum was willing to relinquish its objects in order to re-unite the statue, but, after consultation with the Turkish authorities, it was agreed that a reproduction of the entire statue might be made using molds taken from the separate pieces. In exchange for the right to make molds of the torso in Turkey, the Getty Museum promised to send new bronze reproductions of the head and foot in its possession to Burdur, and agreed to have its conservator perform needed work on the torso before the molds were made.

A temporary exhibition in the Getty Museum shows the ancient head and foot alongside the modern bronze reproduction of the statue from which they came. Also on view will be the foundry's working plaster model taken from the molds and a display describing the making of the reproduction. This presentation obeys the dictates of modern taste and curatorial principles which do not allow restoration carried to the point of reconstruction. But, even barring these important scruples, the torso itself, crushed and misshapen in burial, would have thwarted any attempt to graft ancient pieces onto a reproduction of it. In fact several adjustments were required to re-align the parts for the reconstructed model.

Molds of the separate pieces were thus sent to the Valsuani foundry in Paris, where plaster models were made from them. These plaster castings were fitted together as the first step in assembling the new statue. The Getty Museum conservator was present to make necessary adjustments in the plaster model and to consult with the foundry on all steps of the complex process, described below, leading to the actual pouring of the bronze. Technically, this process differed little in its essentials from that used by the Romans in antiquity to cast the original statue.

This method is known as lost-wax bronze casting, or *cireperdue*, and has been practiced for at least 6,000 years. The basic principle of this technique — "wherever there was wax there will be bronze" — has enabled sculptors from ancient times to the present to cast in bronze their most intricate, detailed, and subtle creations.

The very first attempts at lost-wax casting were small figurines modeled in solid wax and covered with a fire-resistant material, such as clay, with a duct at the top and a vent in the bottom. The wax was then burned out and the molten metal poured in. When the clay mold was chipped away, a solid bronze reproduction of the wax original was revealed.

By forming solid wax models, however, the ancient sculptor was limited to the casting of very small figures since bronze shrinks considerably as it cools. The proportionally greater amount of shrinkage in large solid works would distort the pieces and ruin their surfaces. The answer to this problem was the more difficult method of hollow bronze casting. By the fifth century the Greeks had so refined this process that they could produce statues of large and even colossal size. In hollow bronze casting, a thin layer of wax is modeled over a fire resistant core, then covered with an outer fire-resistant mold. With an intricate system of ducts, gates, and vents, a large bronze sculpture with walls of relative thinness could be poured, thus minimizing shrinkage and surface distortion. The Romans developed great technical virtuosity in this art, eventually casting monumental statues whose bronze walls ranged from 1/16" to 1/8" thick.[1]

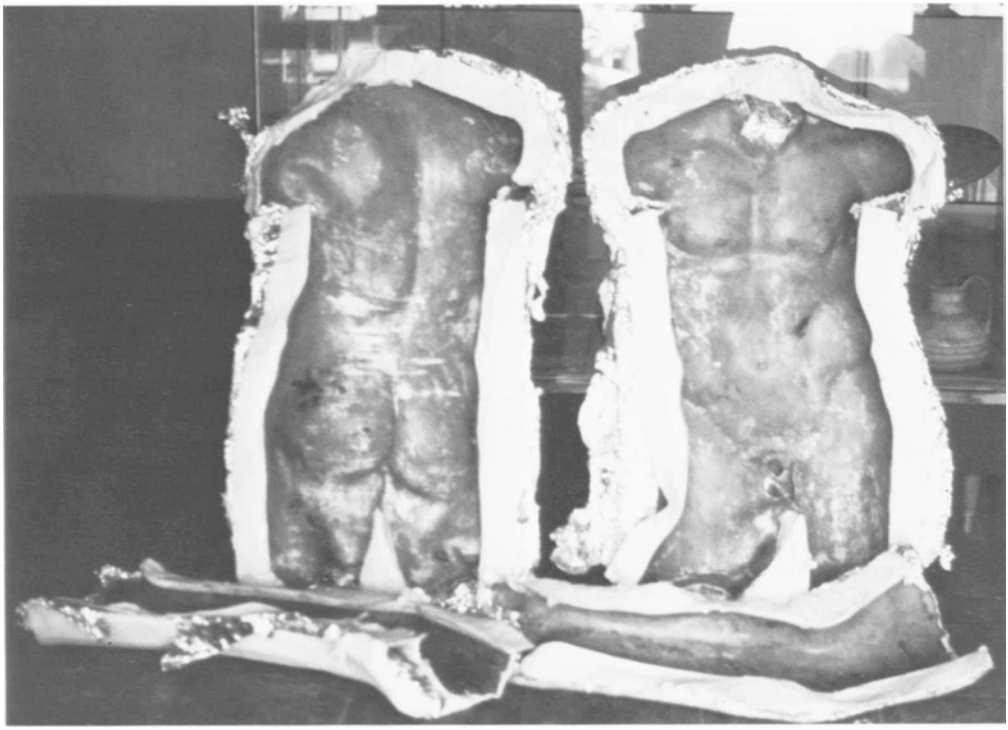
In making the reproduction of the ancient bronze for the Getty Museum, the Valsuani founders and the Museum conservator employed such modern technological improvements as natural latex rubber for mold material and various refractory materials, plaster, and polyurethane foam for the rigid molds. Nevertheless, the lost-wax casting procedure remains essentially that of the Romans.

Procedures followed in casting the new statue

1. Taking the molds of the statue in Burdur

Two initial molds are necessary: a rubber mold to render the details, and a rigid polyurethane mold (called a "mother" mold) to provide support for the former.

(a) Prior to the mold-making procedures, the torso was carefully examined and the breaks recorded and photographed.
(b) The statue was sectioned off down its sides into two parts, back and front, with masking tape. Any breaks or holes in the surface were plugged with synthetic microcrystalline wax, and the whole statue was given a thin coat of wax to facilitate eventual removal of the molds.
(c) To make the first mold, natural latex rubber emulsion was applied in horizontal layers over the entire surface of the torso



The rubber detail mold taken from the torso
in Burdur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and leg, and allowed to dry for six hours. This procedure was repeated another fourteen times. Then the statue was removed from its mounting and the leg separated from the rest of the body. The torso was laid on its back and, with cardboard sheets and more tape, walls were constructed on the foundation of the first lot of masking tape. The entire construction — rubber mold coating, masking tape and cardboard walls — was covered with aluminum foil to form, when the seams were masked with tape, a watertight, heat-reflecting insulation and means of separation.

Binary expanding polyurethane was then mixed and poured onto the surface of the aluminum. The polyurethane expanded to cover, within five minutes, the entire area of mold material, masking and wall. The figure was turned onto its stomach, so that it now rested on the expanded polyurethane which had just been applied, and the identical procedure was carried out on the back. The disconnected leg was treated in the same manner.

(d) The expanded, stiff polyurethane was pared down to a thickness of 3.2784" and carved to conform to the body shape of the bronze figure.

(e) The rigid polyurethane molds, since they had been formed over the aluminum, were easily removed from both sides of the torso and the leg.

(f) The rubber emulsion, all fifteen layers, was easily peeled from the surface of the wax-coated bronze. The rubber detail molds, along with the rigid polyurethane ones, were then crated and shipped to the J. Paul Getty Museum.

After contracting with Valsuani Foundry to make our statue, the Museum sent both sets of molds to Paris to begin the casting process. Detailed below are the general procedures employed in lost-wax bronze casting, with occasional more precise specifications regarding the making of this particular statue.

2. Making the plaster model

In order to correct ancient damages to the statue and assure that the different pieces will join properly to form one statue, a plaster model is made.

(a) First, the rubber molds are measured at their margins and fitted into the rigid "mother" molds.

(b) Each supported rubber mold is painted on the inside surface with wet plaster to remove the air bubbles from grooves and cavities and to preserve fine sculpted detail. The whole mold surface is then covered with layers of plaster strengthened with cloth fiber, to a thickness of 1/2". At this point further strength is provided by wooden supports which are set in each mold section and fixed with wet plaster and fiber.

Making the molds for the wax model. (This photograph only represents the process and is not of the Getty statue.)

(c) The rubber and support molds are now removed from the plaster. The separate plaster sections can be fitted together, and altered if necessary, to make sure that they join properly and that ancient damages and casting faults in the original parts are corrected. Alterations and joins between parts are made with plaster and then contoured to conform to the adjoining surfaces: Any surface details are continued and textures matched to the surrounding areas.
(d) Finally, metal support rods are tied into the leg and foot of the plaster model to prepare for the secondary mold-making procedures.

3. Making the molds for the wax model

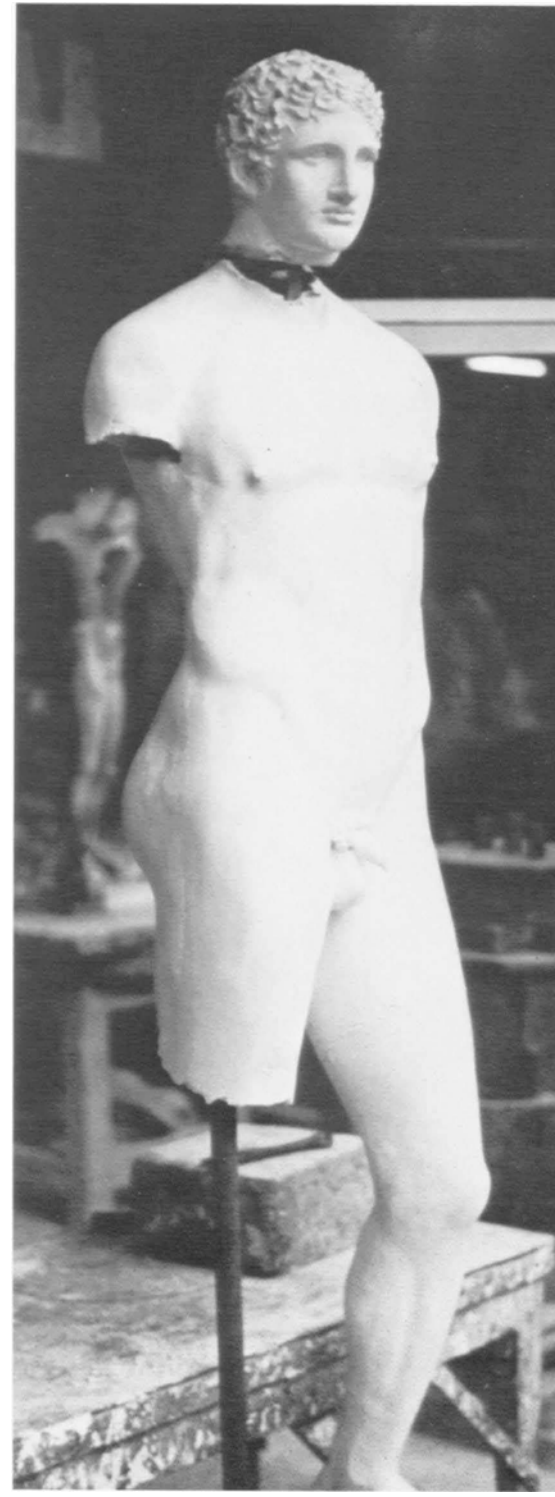
Why, one might wonder, couldn't wax be used from the very beginning, instead of plaster, for the operations described in Step 2? If the sculpture is small enough, wax can indeed be used to make the necessary alterations and joins, but in this case, with a statue over seven feet tall, the wax would not have been strong enough to support its own weight without buckling and losing its shape. Besides this, the thickness of the wax must be as even as possible all over; otherwise, the molten bronze which will displace it will crack in shrinking, thus weakening the structure and distorting the surface design of the piece.

The next three steps are in preparation for the wax model.

(a) First, the entire outer surface of the plaster model is given several coats of shellac to form a water-tight seal over the porous plaster.
(b) Next, an inch-thick layer of hot gelatin — a special variety made from pectin — is applied to the surface of the plaster model. After the gelatin has cooled, it is cut into sections along certain lines so that it can easily be removed from difficult areas like the nostrils, ears, underarms, etc.
(c) Another plaster mold, this time a "mother" (or support) mold, is made over the gelatin surface. This plaster mold is 2" thick, reinforced with fiber and wooden struts, and is made to come apart into four sections.

4. Slushing the hot wax to form the wax model

(a) At this point, we have a plaster support mold surrounding the gelatin model. Hot wax is now poured inside the mold and the whole form is rotated in every direction so that the wax can reach and cover the entire surface of the gelatin mold. More hot wax is poured in and the molds rotated until the desired thickness of wax (which is ultimately the thickness the bronze will be) is built up. The wax in our statue was approx. ¼" thick.



The wax model. The five loops sunk into the statue are major chaplets or separating devices for the outer and inner molds.

(b) Once the wax has cooled, the resulting model is filled with a liquid mixture of sand, plaster, brick, and organic filler which, when hardened, will first support the wax model and then serve as the inner core of the final mold. This rigid core, or investment, must also be porous to absorb all the gases produced in the molten bronze.
(c) Now the molds (gelatin and supporting plaster) are removed, to reveal a complete copy of the statue in wax. The wax figure is then cleaned and altered if necessary.
(d) Iron dowels 1/8"-1/16" thick and 2"-3" long are now pounded through the wax into the core material. These pins are called chaplets and will eventually hold the outer and inner molds at the desired distance from each other when the wax is melted out. The placement of the chaplets over the surface is arbitrary, but they are usually placed in rows in areas where they will not interfere with design features. In our statue there were more than thirty such chaplets.

5. Adding ducts and vents to the wax model

Two networks of channels are now added to the surface of the wax; one of these will convey the molten bronze into the statue cavity, while the other will allow the air to escape as it is expelled by the liquid metal. The wax dowels which form these two systems are usually ½" in diameter in statues of this size.

Mold material is applied over the model and the system of ducts and vents.

(a) The ducts, or conveyance tubes, run parallel to the direction of flow of the molten metal and converge just above the statue into a funnel-shaped cup. The vents, or air escape tubes, usually run parallel to the ducts and form a net-like system around the pour-cup. The placement of both sets of tubes is extremely important. Undercut parts of the statue are filled by the bronze not as it is poured downward but as it is forced to rise into new ducts by the pressure from above. In these cases the vents must be properly placed to allow the air to escape, for any trapped air would leave a hole in the final figure.

6. Adding the outer mold layers

(a) The complex of wax model, inner core, and system of ducts and vents is encased in a thin layer, approximately 1/8" to 1/4" thick, of a viscous material. This is composed of the finest delta sand, mixed with chopped organic matter, such as straw, grass and horse manure, which is allowed to sit and ferment. The gases formed in the mixture during fermentation create, in this thin layer surrounding the wax figure, *vacuoles,* which will eventually serve, like the inner core, to absorb the gases produced in the pouring of the molten bronze. As it dries the sand mixture shrinks onto the wax model and adheres to it.
(b) Once the thin impression layer is sufficiently dried, a spongy mixture of coarser-

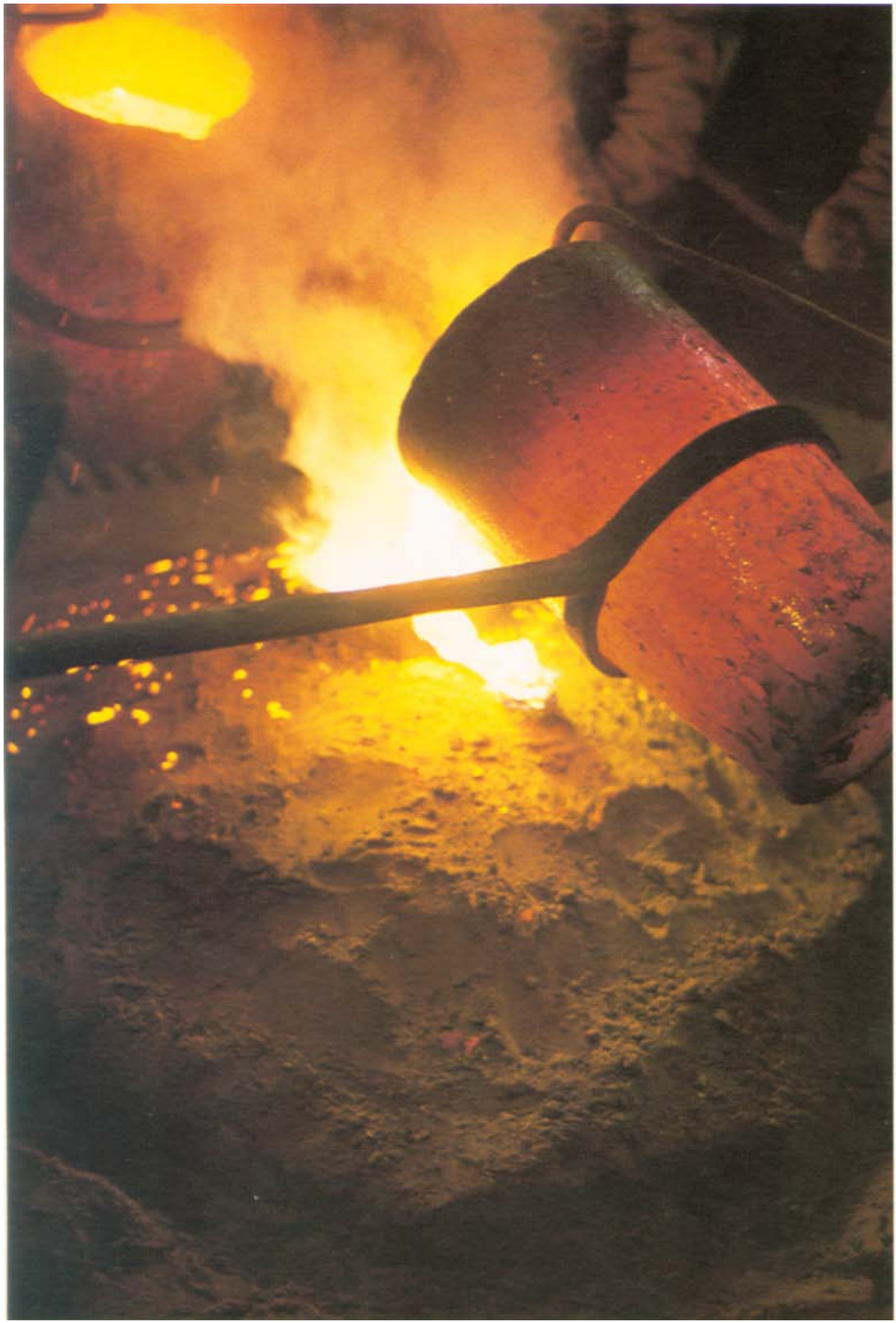
grained sand, clay and mud is applied and strengthened with ¼" iron wire net, layer by layer, until the desired thickness (in this case, 5"-7") is achieved.
(c) Over this entire assemblage a layer of plaster, 2" thick, is finally added.

7. Making the bronze and pouring the statue

Bronze is an alloy, formed by melting two or more metals together. Alloys have various properties which make them more useful than simple metals. The addition of one metal to another in a melt lowers the temperature at which they will become liquid. An alloy can usually be tempered to a greater degree of hardness than any of the separate metals alone. The combination of different metals can also promote malleability, patination possibilities, ability to avoid oxidation, and will be better tempered and easier to weld. Some alloys, including bronzes, are different in color from the metals from which they are created. Our bronze was made in the foundry in the following way.

(a) The major components in the bronze alloy, presented in order of greatest percentage, are: copper, zinc, tin, lead.
(b) The metals are placed in a gas-heated furnace. Various salts of borax are added to purify the mixture and to form a discrete layer of slag.
(c) The foundry crew tests the mixture constantly by sticking an iron rod into the melting metals and drawing off a layer of glassy slag, formed by silica borax salts containing fluxing agents, and those bits of the alloy which have been able to form at that particular temperature.
(d) The melt is measured by thermometer. When the temperature reaches 1,200° C, the metal is ready to pour.
(e) Meanwhile, the mold has been sunk in the ground in a specially designated area of the foundry. This is so that the explosive pressures generated when the hot metal touches the relatively cool molds can be contained. The earth acts as a giant "heat sink"; it absorbs the heat from the statue very gradually and evenly.
(f) The hot metal is transferred from the gas furnace to the mold in thimble-shaped ceramic vessels 2½' high, 8"-10" wide and 2" thick. The vessels are heated over gas furnaces to a temperature close to that of the alloy. They glow red-hot as they await the white-hot metal.
(g) The top layers of liquid metal and slag are poured into the first transfer vessel, and the impurities are lifted off with ladles and discarded. Often there are added to the molten metal mixtures of salts and magnesium which flash brightly as they burn off or oxidize unwanted ingredients.
(h) The metal is carried from the furnace to

Melting the metals to make the bronze



Pouring the bronze

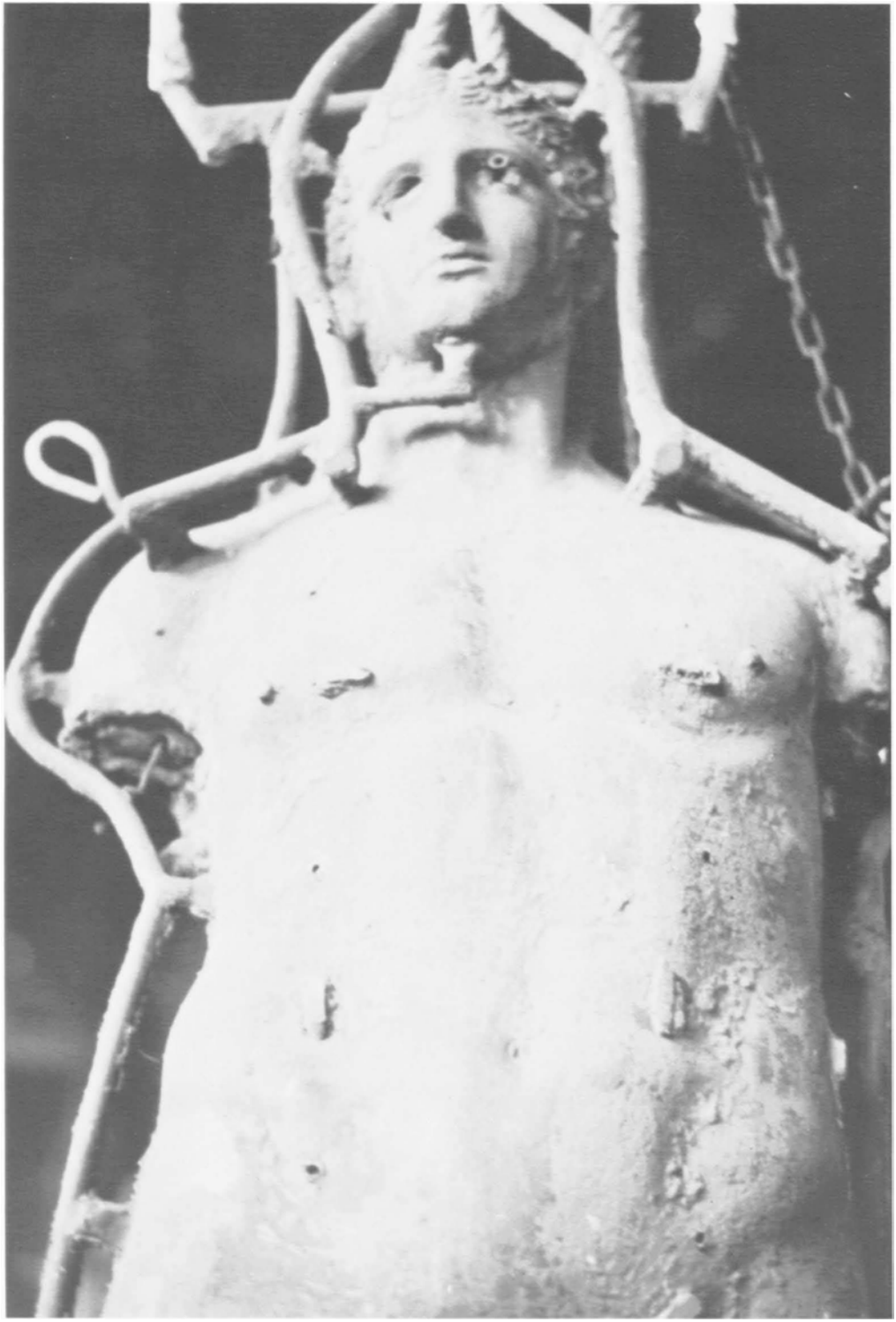
the mold and poured into it, filling the space evacuated by the burnt-out wax. The foundry workers know the mold has been filled when metal begins to issuing out of a ducts or vents, igniting the paper wads they contain. This is the signal that the pour is complete.
(i) The metal is allowed to cool in the earth for 24-48 hours.

8. Removing the mold material and metal support structures

(a) The mold material is shattered with a sledge-hammer, layer by layer, and removed. Metal support structures are disconnected and removed. Eventually the bronze emerges.
(b) As the mold material disappears the ducts, vents, and chaplets are revealed. The surface of the bronze is covered with a fire skin of various colors. We have decided to preserve many of the colors and areas of green oxidation on our statue to give it an appearance more nearly approximating an ancient one that has been excavated from the ground.
(c) The core is removed with a vibrating tool through natural openings in the statue, such as the hole left by the missing arm.

9. Chasing, repairing, and preparing the statue for display

(a) The ducts and vents are sawed off the statue. The chaplets are twisted off.



Chasing the statue. (Compare with previous photograph: holes on chest indicate where chaplets were removed; raised lines show connection points of ducts and vents.)

(b) The raised areas where ducts and vents joined the statue are carefully filed down level with the surface. These areas are a bright yellow-brown in color because they have no fire skin. They must therefore be patinated to match the surrounding surface with various chemical combinations plus heat and the occasional addition of moisture.
(c) There are several areas in our bronze where the metal has failed to join or to fill its space properly. These spots, and the holes formed by the removal of the chaplets, are strengthened or filled by welding, using excess bronze from the melt which has been poured into appropriate shapes for this very purpose.
(d) Two metal pins and their threaded attachments are welded into place in the bottom of the foot and at the truncation of the left leg to support the statue on its plinth.

David Rinne, *Conservator*

Footnote

1 See Harry Jackson, *Lost Wax Bronze Casting*, Flagstaff, Arizona, 1972

Photo nos. 4 & 5 by M. Feuillot, Paris
All other photos by David Rinne